

PATENT

Case Docket No. 36856.324

Date: July 11, 2000

BOX PATENT APPLICATION
ASSISTANT COMMISSIONER FOR PATENTS
Washington, D.C. 20231

Sir:

Transmitted herewith for filing is the patent application of:

Inventor(s): Takaei KIHARA

For: LOUDSPEAKER

☐ Applicant(s) claim(s) benefit under 35 U.S.C. § 119(e) of United States provisional application No. _____ filed _____

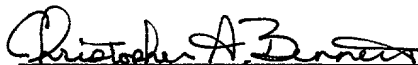
Enclosed are:

- 11 Pages of Specification
 3 Sheet(s) of drawings (☐ formal ☒ informal)
☒ Declaration and Power of Attorney ☐ Will follow.
☒ Form PTO-1595 and an Assignment of the invention to Murata Manufacturing Co., Ltd. of 26-10 Tenjin 2-chome, Nagaokakyo-shi, Kyoto-fu 617-8555, JAPAN ☐ Will follow
☒ A certified copy of Japanese Patent Appln. No. 11-211684 filed on July 27, 1999, from which priority is claimed in the subject case pursuant to Rule 55b and 35 U.S.C. 119. ☐ Will follow.
☐ A verified statement to establish small entity status under 37 CFR 1.9 and 37 CFR 1.27.
☐ Information Disclosure Statement, Form PTO 1449, and _ cited reference(s).
☐ Change of Correspondence Address
☐ Preliminary Amendment
☒ General authorization/request to Petition for Extensions of Time
☒ Return Postcard

FOR:	NO. FILED	NO. EXTRA	SMALL ENTITY RATE	SMALL ENTITY FEE		OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY FEE
BASIC FEE				\$345.00	OR		\$690.00
TOTAL CLAIMS	12	-20=	X 9	\$	OR	X 18	\$-0-
INDEP CLAIMS	1	-3=	X 39	\$	OR	X 78	\$-0-
_0 MULTIPLE			X+ 130	\$	OR	+ 260	\$-0-
DEP CLAIMS PRESENTED			TOTAL =			TOTAL:	\$690.00

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☐ Any filing fees under CFR 1.16 for presentation or extra claims.

Respectfully submitted,



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LOUDSPEAKER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a loudspeaker and more particularly to a high-frequency loudspeaker using a spherical or hemispherical vibrator.

2. Description of the Related Art

Fig. 5 is a partially cutaway perspective illustration of one example of conventional loudspeakers. A loudspeaker 1 using a spherical or hemispherical vibrator has been proposed as a nondirectional high-frequency loudspeaker. The spherical or hemispherical vibrator 2 is composed of a vibrating object 3 made up of a spherical or hemispherical piezoelectric material on the internal and external surfaces of which electrodes 4 and 4 are provided as shown in Fig. 5 and is driven by a driving mechanism 5, such as an amplifier, connected to the electrodes 4 and 4.

However, the conventional loudspeaker 1 exhibited an uneven sound pressure characteristic as shown in Fig. 6 because the sound pressure is intensified at the natural resonant frequency F_0 of the resonator 2, and diminished at

other frequencies.

SUMMARY OF THE INVENTION

To overcome the problems described above, preferred embodiments of the present invention provide a loudspeaker using a spherical or hemispherical vibrator which has an exceptional and flat sound pressure characteristic.

A loudspeaker according to preferred embodiments of the present invention includes a spherical or hemispherical vibrator, a first baffle board on which the vibrator is mounted, a second baffle board arranged with a space between the first and second baffle board, and spacers which connect the first and second baffle boards.

In a loudspeaker according to preferred embodiments of the present invention, the vibrator is configured so that it has a natural resonant frequency higher than the desired bandwidth of the loudspeaker.

Further, in a loudspeaker according to preferred embodiments of the present invention, the baffle boards are configured so that they have the natural resonant frequencies which is lower than that of the vibrator.

Further, in a loudspeaker according to the preferred embodiments of the present invention, the first and second baffle board are desirable to have the natural resonant frequencies which are different from each other.

Further, in a loudspeaker according to preferred embodiments of the present invention, the natural resonant frequency of the space is set at a frequency which is different from the natural resonant frequency of the vibrator and the resonant frequencies of the baffle boards.

The sound pressure characteristic of a loudspeaker is improved by mounting a spherical or hemispherical vibrator on a baffle board. However, because there is a frequency at which the sound wave coming from the front side of the baffle board and the sound wave from the back side offset each other, in a single baffle board the sound pressure characteristic is irregular and accordingly the improvement of the sound pressure characteristic is insufficient. In this invention, by giving a plurality of baffle boards and producing a plurality of peaks in the sound pressure characteristic, the sound pressure characteristic is flattened, thus substantially improving the sound pressure characteristic.

Other features, elements, characteristics and advantages of the present invention will become more apparent from the following detailed description of preferred embodiments and with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view showing one preferred embodiment of a loudspeaker according to the present invention;

Fig. 2 is a sectional view taken on line II - II of Fig. 1;

Fig. 3 is a sectional view taken on line III - III of Fig. 1;

Fig. 4 shows the sound pressure characteristic of the loudspeaker shown in Fig. 1;

Fig. 5 is a partially cutaway perspective illustration of one example of conventional loudspeakers; and

Fig. 6 shows the sound pressure characteristic of the conventional loudspeaker shown in Fig. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 is a perspective view of one preferred embodiment of a loudspeaker according to the present invention.

The loudspeaker 10 includes a hemispherical vibrator 12 to convert an electrical signal into mechanical vibration. The vibrator 12 includes a hemispheric vibrating object 14 made of a piezoelectric material of, for example, ceramics, or other suitable piezoelectric material. On the curved

internal and external surfaces of the vibrating objects 14, electrodes 16a and 16b are provided as a driving mechanism for driving the vibrating object 14. The vibrating object 14 is polarized in the thickness direction from the internal surface to the external surface. Further, the vibrator 12 is configured to have the natural resonant frequency higher than the desired bandwidth of the loudspeaker 10.

As for the vibrator 12, the end surface on the opposite side of the hemispherical curved surface is mounted on the main surface of a first baffle board 18. An adhesive is used for mounting to vibrator 12 to the first baffle board 18.

On the side of the first baffle board 18 opposite from the side where the vibrator 12 is mounted, a second baffle board 20 is arranged to be approximately in parallel with the first baffle board 18. In this loudspeaker 10, the second baffle board 20 has a diameter which is greater than that of the first baffle board 18. These baffle boards 18 and 20 are made of materials such as resin, wood, metal, or other suitable material. Further, the natural resonant frequency F_a of the first baffle board 18 and the natural resonant frequency F_b of the second baffle board 20 are set to be lower than the natural resonant frequency F_0 of the vibrator 12, and, furthermore, the natural resonant frequency F_a of the first baffle board 18 and the natural

resonant frequency F_b of the second baffle board 20 are set to be different from each other.

The first baffle board 18 and second baffle board 20 are connected by, for example, four spacers 22. By adjustment of the length of the spacers 22, the volume of a space 24 between the first baffle board 18 and the second baffle board 20 is adjusted, and in this way the resonance frequency F_c of the space 24 can be adjusted to any desired value. In the loudspeaker 10 of the present embodiment, the resonance frequency F_c of the space 24 is set at an intermediate value between the natural resonant frequency F_a of the first baffle board 18 and the natural resonant frequency F_b of the second baffle board 20.

In the loudspeaker 10, the vibrator 12 is mounted on the first baffle board 18, the first baffle board 18 and the second baffle board 20 are connected by the spacers 22 with the space 24 between them, and, furthermore, the natural resonant frequency of each of the vibrator 12, the first baffle board 18, and the second baffle board 20, and the resonance frequency of the space 24 are different from one another. Accordingly, as shown by a broken line in Fig. 4, a plurality of peaks are produced in the sound pressure characteristic over a wide frequency band and the sound pressure characteristic is effectively flattened. Therefore, the sound pressure characteristic of the loudspeaker 10 is

greatly improved.

According to the present invention, with the flat sound pressure characteristic over a wide frequency band, the sound pressure characteristic is greatly improved and as a result a loudspeaker showing a sufficient sound pressure characteristic in the set bandwidth is achieved.

It should be understood that the foregoing description is only illustrative of the present invention. Various alternatives and modifications can be devised by those skilled in the art without departing from the invention. Accordingly, the present invention is intended to embrace all such alternatives, modifications and variations which fall within the scope of the appended claims.

WHAT IS CLAIMED IS:

1. A loudspeaker comprising:
a spherical or hemispherical vibrator;
a first baffle board to mount the vibrator;
a second baffle board arranged with a space between
the second baffle board and first baffle board; and
a plurality of spacers for connecting the first
baffle board and second baffle board.
2. A loudspeaker as claimed in claim 1, wherein the
vibrator has the natural resonant frequency higher than the
desired bandwidth of the loudspeaker.
3. A loudspeaker as claimed in claim 1, wherein the
first and second baffle boards have natural resonant
frequencies which are lower than the natural resonant
frequency of the vibrator.
4. A loudspeaker as claimed in claim 1, wherein the
first baffle board and second baffle board have the natural
resonant frequencies which are different from each other.
5. A loudspeaker as claimed in claim 4, wherein the
first and second baffle boards have natural resonant

frequencies which are lower than the natural resonant frequency of the vibrator.

6. A loudspeaker as claimed in claim 1, wherein the resonance frequency of the space is different from the natural resonant frequency of the vibrator, and different from the natural resonant frequencies of the baffle boards.

7. A loudspeaker as claimed in claim 1, wherein the resonance frequency of the space is lower than the natural resonant frequency of the vibrator.

8. A loudspeaker as claimed in claim 6, wherein the resonance frequency of the space is lower than the natural resonant frequency of the vibrator.

9. A loudspeaker as claimed in claim 1, wherein the resonance frequency of the space is higher than one of said first and second baffle boards, and lower than the other of said first and second baffle board.

10. A loudspeaker as claimed in claim 6, wherein the resonance frequency of the space is higher than one of said first and second baffle boards, and lower than the other of said first and second baffle board.

12. A loudspeaker as claimed in claim 1, wherein said first baffle board is approximately circular.

ABSTRACT OF THE DISCLOSURE

A loudspeaker contains a hemispherical vibrator. The end portion of the hemispherical vibrator on the side opposite to the hemispherical curved surface is mounted on the main surface of a first circular baffle board. On the opposite side of the first baffle board from the side where the vibrator is mounted, a second baffle board is arranged so as to be approximately parallel with the first baffle board. The first baffle board and second baffle board are connected by four spacers with a space between them.

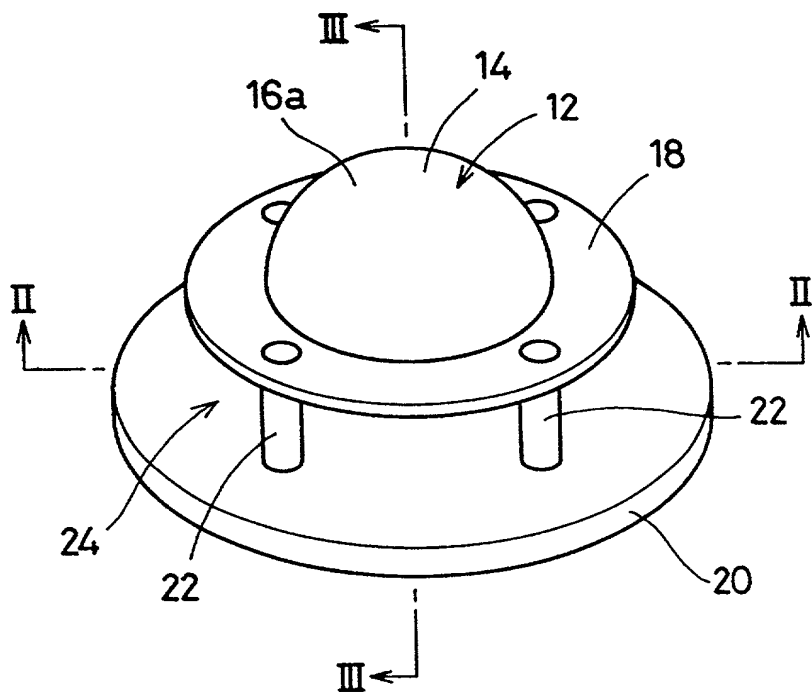
【書類名】

図面

【図 1】

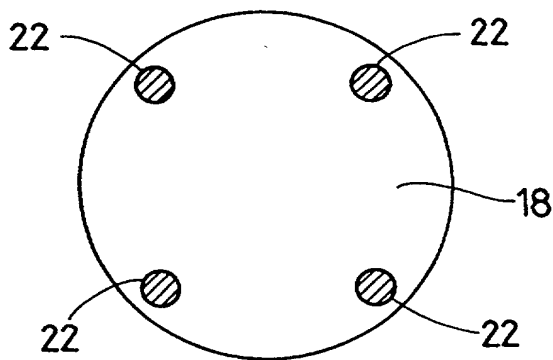
FIG. 1

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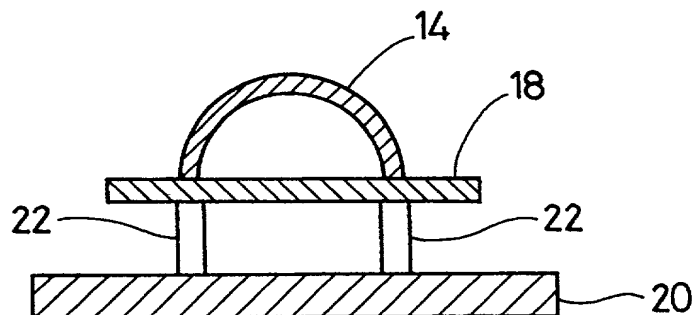
【図 2】

FIG. 2



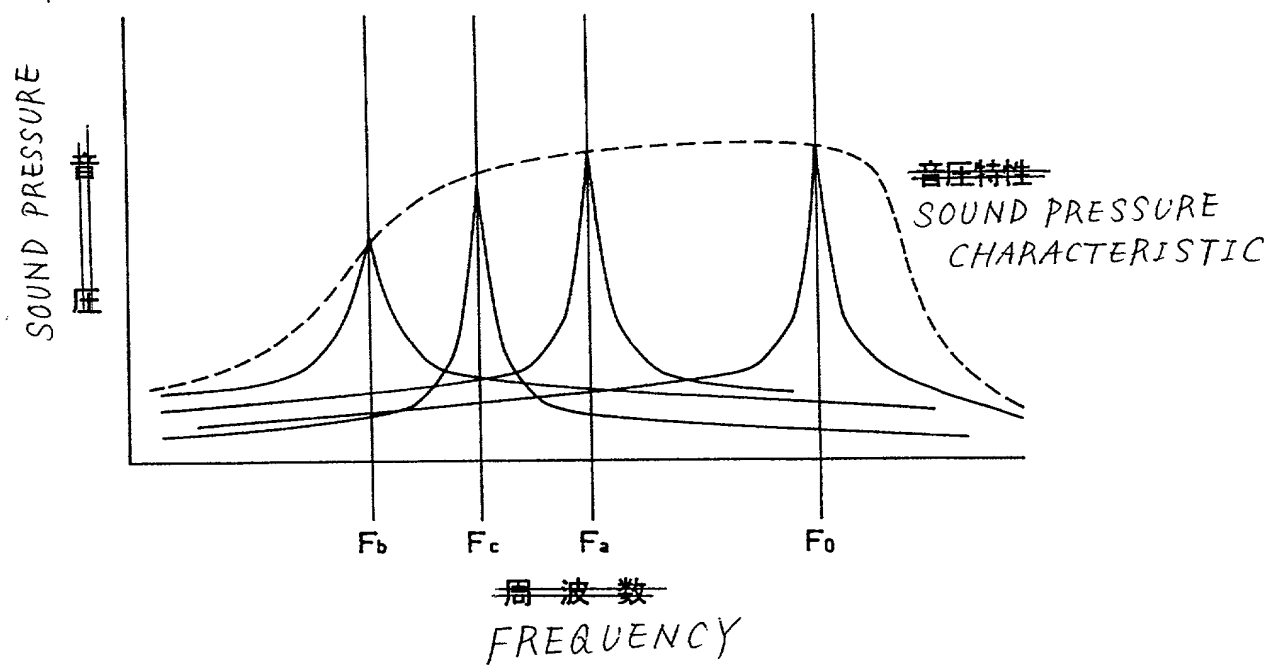
【図3】

FIG. 3



【図4】

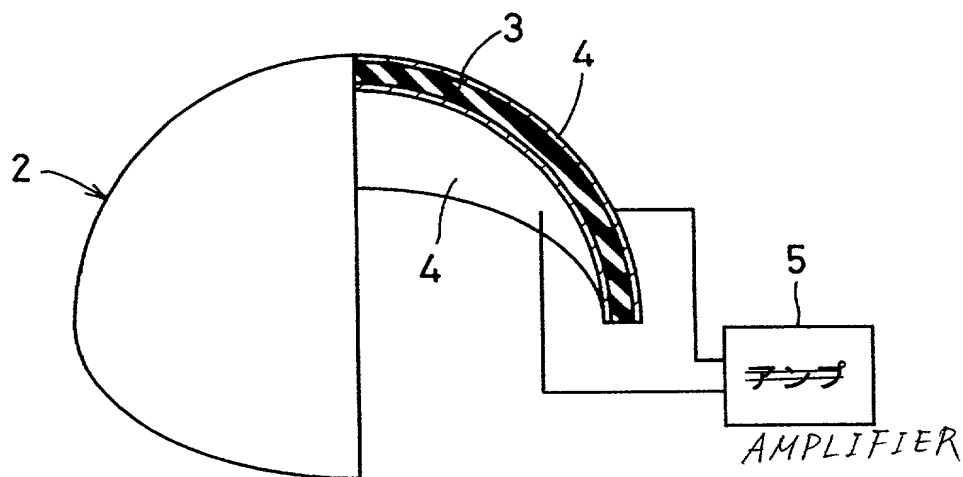
FIG. 4



~~図5~~

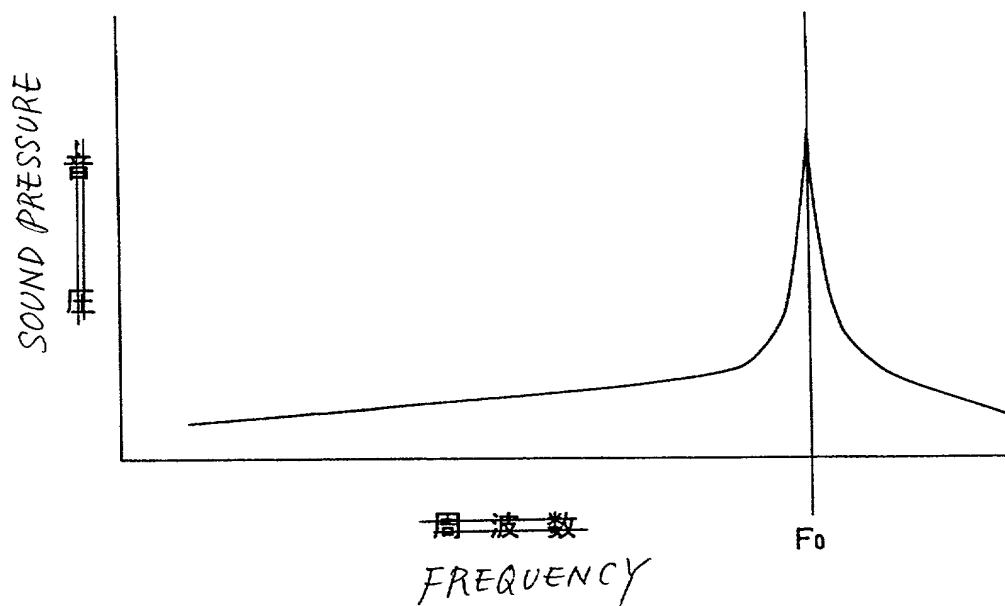
FIG. 5

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~~図6~~

FIG. 6



Attorney Docket No. 36856.324

DECLARATION FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **LOUDSPEAKER** the specification of which is attached hereto unless the following box is checked:

☐ was filed on _____ as United States Application Number or PCT International Application Number _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)	Priority Date	Priority Claimed
11-211684 (Number)	JAPAN (Country) (PCT)	July 27, 1999 (Day/Month/Year Filed)
		Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below.

(Application Number)	(Filing Date)

(Application Number)	(Filing Date)

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

(Application Number)	(Filing Date)	(Status - patented, pending, abandoned)

(Application Number)

(Filing Date)

(Status - patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of first inventor (given name, family name) Takaei KIHARA

Inventor's signature Takaei Kihara Date July 10, 2000

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